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THE EFFECTS OF INTERGOVERNMENTAL GRANTS ON LOCAL REVENUE: EVIDENCE FROM CHILE

Javiera Bravo*

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*jpbravo@uc.cl

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Javiera Bravo

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Abstract

This paper presents research on the effect of intergovernmental grants on local government revenue in Chile. Intergovernmental grants are endogenous and I exploit a kink in a component of the Chilean formula for resource distribution for a panel of 340 Chilean municipalities from 1990 to 2007. I find empirical evidence that for Chilean municipalities, intergovernmental grants have a negative effect on local revenue. Specifically, an increase in per capita grant amount of one standard deviation is associated with a decrease of between 0.25 and 0.32 standard deviations in local per capita revenue. This effect is not uniform for different kinds of local revenue.

Keywords: Fiscal Decentralization; Intergovernmental Grants; Local government revenue; Local collection; Regression Kink Design

1 Introduction

According to traditional literature on fiscal federalism, one of the benefits of decentralization is more efficient allocation of local public goods. The efficiency level of a local public good varies from one jurisdiction to another; each jurisdiction presents different preferences and cost conditions. As subnational governments are much closer to the population of their jurisdictions, they tend to have greater knowledge about such preferences and cost conditions than central governments do (Tiebout, 1956; Oates, 1999). Moreover, this closeness provides a benefit in terms of accountability (local control over local outcomes). However, since subnational governments have varying fiscal capacities[1] and must carry out the functions assigned to them, fiscal inequalities will arise among these jurisdictions (Buchanan, 1950).

Intergovernmental grants are important fiscal instruments designed to produce fiscal equalization among jurisdictions[2] [3] as long as a certain minimum level of local public goods is assured. Redistributive intergovernmental grants channel funds from relatively wealthy jurisdictions to poorer ones and can vary according to the recipient's degree of autonomy in deciding how to spend them. This paper focuses on unconditional grants, which may be used in any way that the recipient municipality desires, and are an appropriate vehicle for the purposes of fiscal equalization (Oates, 1999). In addition, this kind of grant may be vertical (between governments at different levels) or horizontal (between governments at the same level).

The design of redistributive grants requires the definition of a mechanism for distributing the resources and, for horizontal grants, a contribution mechanism that determines which jurisdictions will provide resources to others and the amounts of their contributions. The allocation of redistributive grants is often based on a formula that takes into consideration

[1]Fiscal capacity is the ability to generate revenue, which depends on resources available within each jurisdictions geographical area. It is generally measured by the size of the tax base.

[2]The literature emphasizes other potential roles of intergovernmental grants such as internalization of spillover benefits to other jurisdictions, stimulation of local economic development and capacity to cope with idiosyncratic regional income shocks in a federal state (risk-sharing). More recently, Johansson (2003) analyzes intergovernmental grants as a tactical instrument, i.e., finding that politics influence the allocation of governmental resources to regions.

[3]Oates (1999) presents a discussion of the role of equalizing intergovernmental grants in fiscal federalism from the perspective of redistributing income and promoting development in poorer regions.

the fiscal need and fiscal capacity of each jurisdiction. Fiscal capacity is often measured by the tax revenue collected, while the total amount of resources to be distributed can be determined by the contribution of all or some jurisdictions. This contribution may take the form of a lump sum or a proportion of the tax revenue collected. My future research will explore the effects of the grant's design.

Intergovernmental grants may produce effects other than the desired ones. When subnational governments are responsible for collecting taxes, the total amount of revenue collected depends mainly on how efficient they are in this task as well as their success in finding alternative sources of revenue (i.e., fiscal effort); however, revenue collection is a costly activity for subnational governments. Grants increase the total revenue of jurisdictions, and due to an income effect, jurisdictions would then exert less fiscal effort and collect less local revenue. Thus, an increase in grants to a local government may decrease its collected local revenue, implying that local governments do not exploit their full fiscal capacity.

As in most countries, intergovernmental grants represent a significant source of local revenue in Chile. Thus, it is important to know if they cause a disincentive to collect revenue. In Chile, local governments (municipalities) collect most local revenue. The redistributive grants are unconditional and horizontal and are transferred through the Municipal Common Fund (Fondo Comn Municipal, or FCM). Among other variables, municipal revenue is taken into consideration in determining how these resources are distributed, and municipalities in turn must contribute a share of their local revenue to the FCM. In this paper I study the effects of grants (FCM) on local revenue in Chile[4].

To determine the causal relationship between grants and local revenue (the income effect), intergovernmental grants are considered endogenous, which leads to an identification problem. There are different sources of endogeneity. First, local revenue is partly determined by unobserved local characteristics which are related to the grant amounts. In other words, the grants are not randomly distributed. Second, not all variation in grants is exogenous to local revenue because local revenue influences the amounts of grants. Third, the local revenue data could contain measurement errors.

[4] In Chile, there is little empirical evidence to support the existence of these effects, although the potential incentive of the FCM is mentioned regularly in debates about decentralization in Chile.

The identification strategy used is based on a kink in a component of the Chilean formula for resource distribution. This component is related to the local revenue collected during at least the previous two years and functions only for municipalities with per capita local revenue which is below the national average. Otherwise, this component equals zero. Further, I use the grant from local revenue component as an excluded instrument and control for local per capita revenue of at least the previous two years. Therefore, the residual variation in grants from the local revenue component is driven by the shape of the formula, which is unrelated to unobserved determinants of local revenue. Moreover, this identification strategy purges the effect of local revenue from FCM grants.

Research using this identification strategy includes Dahlberg et al.(2008), who study the causal effects of unconditional grants on local spending and tax rates[5]. They use a panel of 279 Swedish municipalities observed over nine years. The Swedish grant system is horizontal and consists of different kinds of grants, including cost equalization grants, aimed at reducing differences in structural cost conditions across municipalities. This kind of grant has a specific, self-financed element to compensate for outmigration of persons from local jurisdictions. Municipalities with a net outmigration above 2% receive extra grants whereas municipalities with a net outmigration below 2% do not. This formula for the distribution of funds is used as an excluded instrument in an IV estimation. Since the net outmigration rate might have a direct effect on local spending and taxes, they control for these variables directly in both the first and the second stage of the IV estimation. Finally, they find that federal grants are used to increase local spending, rather than to reduce local taxes. Guryan (2003) estimates the effect of a marginal increase in education spending on students' outcomes. To identify the effect of interest, he uses the formulas of two redistributive state grants as instruments of per-pupil classroom expenditure; these are nonlinear, discontinuous functions of indicators constructed for each district. In the first stage and the second stage estimation, he controls for continuous function of the indicators and variables the formulas are based on.

This paper uses a panel of 340 Chilean municipalities during the 1990-2007 period. The findings of this paper include empirical evidence that intergovernmental grants have a

[5]Swedish municipalities are free to determine the tax rate of the main source of local government revenues.

negative effect on local revenue. Specifically, an increase in the per capita grant amount of one standard deviation is associated with a decrease between 0.25 and 0.32 standard deviations in local per capita revenue. This effect is not uniform for different kinds of local revenue. The study includes several robustness checks: controlling for socioeconomic variables, alternative measures of revenue and grants, alternative definition of outlier municipalities, exclusion of municipalities founded during the 1990-2007 period, and including only of municipalities close to the kink point. The OLS estimates do not show that grants have a negative effect on local revenue.

There is a great deal of empirical and theoretical research focused on the effects of intergovernmental grants received by subnational governments. This literature considers the impact of horizontal and vertical grants on variables such as local revenue or spending and/or local tax rate.

When the tax rate is at the discretion of local government decision makers, the theoretical and empirical literature has focused on studying the effect of grants on local spending and tax rates. According to Bradford and Oates (1971a, 1971b), who base their work on a median voter model of local public finance, when decentralized governments have already set up an optimal mix of local public and private goods, grants will be distributed to the local population in the form of reduced taxes and fees. That is, grants should be spent just like any other increase in community income[6]. Then, they predict that grants should cause local spending to increase, but by a lower amount than the grant (i.e., grants crowd out local spending) and produce a negative effect on the tax rate. However, there is empirical evidence that does not support this hypothesis; several studies have even found that local public spending increases by an amount equal or greater than the grant, or that grants crowd in local government spending. The literature refers to this empirical puzzle as the "flypaper effect" because money "sticks where it hits"[7].

Several papers have offered different explanations for this puzzle[8]. On the one hand, it is

[6]Grants are expected to be allocated to both local public and private goods in accordance with the income elasticities of the median voter.

[7]Roemer and Silvestre (2002) find that in a model which views collective decisions as the outcome of the electoral competition among political parties, the flypaper effect is not an anomaly.

[8]Hines and Thaler (1995) provide a review of this literature and some explanations for the flypaper effect.

considered a case of fiscal illusion, in which individuals confuse the average and marginal price effects of unconditional grants. Grants reduce the average price of public goods, and individuals base their decisions on this price rather than on the actual marginal tax price[9]. On the other hand, several authors have argued that the flypaper effect is merely a specification problem in the Bradford and Oates' model. The main specification problem identified is the endogeneity of the grants which arises from the omission of variables which affect grants and spending, and from the simultaneity of both variables. For example, Becker (1996) offers evidence that the flypaper effect disappears when instrumenting the federal grant and using a nonlinear functional form for the relationship between grants and spending. Knight (2002), incorporating the political determination of federal grants, provides a theoretical framework for selecting instruments which correct for grant endogeneity and finds no statistical evidence of a flypaper effect. On the contrary, Dahlberg et al. (2008) and Gordon (2004), using different identification strategies, find empirical evidence that supports the flypaper hypothesis. The identification strategies used in these cases are based on exploiting changes in grants which are due to the shape of the distribution formula.

In countries like Chile, where tax rates and definition of tax bases are determined by the central government and are the same throughout the jurisdictions responsible for collecting taxes, the empirical literature has focused on studying the effects of grants on local revenue as a proxy for fiscal effort. As will be discussed below, local revenue collected is a good proxy for fiscal effort when there is no strategic interaction among local governments. If there is strategic interaction, all municipalities could simultaneously make more effort without increasing their collection. The main challenge for estimating the effect of grants on local revenue is the potential endogeneity of grants. The hypothesis that suggests that intergovernmental grants reduce local revenue is known as fiscal laziness. A few recent studies have supported this hypothesis, using different econometric models.

Aragón and Gayoso (2005) study this relationship with data from 1,400 local governments in Peru from 2000 and 2001. They exploit a quasi-experiment and panel data to address the identification problem. In 2001, an additional grant was distributed to local governments

[9]Dollery and Worthington (1995) work with a model of federal expenditure and fiscal illusion and provide empirical support for the existence of the flypaper effect in Australia.

in Peru. The authors examine the distribution of these resources, based on the assumption that this distribution is not tied to local tax collection or total expenditures, even though the grant was conferred to local governments which received the minimum redistributive grant. They use participation in this program as an instrumental variable since it explains increases in grants but it is not correlated to local tax collection. They find that, in Peru, the elasticity of substitution is around -1, which is greater than in Chile[10]. Although they recognize the endogeneity of grants, the validity of their instrument is doubtful because the distribution of the additional grant was not random. Rather, it depended on variables that affected the amount of the redistributive grant and therefore local revenue.

Baretti et al. (2002) study the effects of equalizing transfers on German state tax revenue. German states administer tax collection but they do not choose their own tax rates and bases. Studying annual data from 10 states for the years 1970 to 1998, they find that federal grants have a significant negative effect on state tax revenue. The main drawback of this research is that it considers grants exogenous factors that affect state tax revenue.

Rodríguez (1998) studies the Chilean case and concludes that the FCM meets its redistributive goal, i.e., after the FCM is distributed, municipal revenue distribution is more equitable. In addition, he finds that there is a negative relationship between the local revenue collected and the FCM grants received for the previous two years. This result is valid for the 50% of municipalities that receive more FCM resources, but it does not take into account the grants' endogeneity. The research described in this paper contributes to this literature by providing the first IV estimates of the effect of FCM grants on local revenue in Chile.

The remainder of the paper is organized as follows. Section 2 presents a simple theoretical model for formalizing and motivating the empirical results. Section 3 briefly describes Chilean local government and its intergovernmental grants system and presents the grant formula used in IV estimation. Section 4 presents a motivating result using data from Chile. Section 5 describes the identification strategy. Section 6 describes and presents the data. Section 7 reports the results. Finally, section 8 presents my conclusions.

[10]My estimation of the elasticity of substitution for Chile is -0.20.

2 A motivating theoretical model

I present a simple model for studying the potential effect of grants on local revenues collected (income effect). The model considers the individual decision of a local government with respect to the revenue collected when it receives a horizontal redistributive grant, and revenue collection is costly.

2.1 Local government net utility

Local government has the following net utility function:

$$U = f(Z) - e(X) \tag{1}$$

where Z denotes the public good spending and X denotes the local revenue collected. The function $f(\cdot)$ represents local government preferences (utility function) and is increasing and concave ($f'(\cdot) > 0$ and $f''(\cdot) < 0$)[11]. $e(\cdot)$ is the cost function (or disutility function) and is increasing and convex ($e'(\cdot) > 0$ and $e''(\cdot) > 0$)[12].

2.2 Local government budget constraint

Local governments have two sources of revenue for financing local public good spending: local revenue and redistributive grants.

$$Z = (1 - \alpha)X + G \tag{2}$$

where α denotes the proportion of local revenue that is transferred by a local government to the common fund. G denotes the redistributive grants, which have two components: the component that depends on exogenous variables (fixed component) and the component

[11] That is, decreasing marginal utility is assumed.
[12] That is, increasing marginal cost is assumed.

that is negatively related to local revenue. Thus,

$$G = K + \beta(X; b) \tag{3}$$

where K denotes the component that depends on exogenous variables (fixed component) and $\beta(\cdot; b)$ denotes the component that depends on local revenue, with $\beta'(\cdot; b) < 0$, $\frac{\partial\beta(\cdot;b)}{\partial b} > 0$ and $\frac{\partial\beta'(\cdot;b)}{\partial b} < 0$, where $\beta'(\cdot; b)$ represents the rate at which the grant received decreases due to an increase in local revenue.

2.3 Optimal local revenue

At the local government level, the decision maker chooses the level of local revenue which maximizes the local government's net utility:

$$\underset{x}{Max}\ \text{U = f(Z) - e(X)} \qquad \text{s.a.} \qquad \text{Z = (1-}\alpha\text{)X + K + } \beta(X; b)$$

This maximization with respect to X yields the following first order condition (FOC):

$$f'(Z) \times [(1 - \alpha) + \beta'(X; b)] - e'(X) = 0 \tag{4}$$

The first term corresponds to the marginal utility of increasing collection of local revenue, that is, the marginal utility of an increase in local public good spending multiplied by the fraction of the extra revenue collected that remains with the local government (the marginal benefit of collecting revenue). The second term corresponds to the marginal cost of collecting local revenue. Optimal local revenue is achieved when both terms are equal. Since f(Z) and e(X) are increasing functions, then $[(1 - \alpha) + \beta'(X; b)]$ must be positive. From (4), the optimal local income can be derived as a function X^* = X(α, b, K, parameters of f(Z) and e(X)).

The second order condition (SOC) for optimal local revenue becomes:

$$[(1 - \alpha) + \beta'(X)]^2 \times f'' + f' \times \beta'' - e'' < 0 \tag{5}$$

2.4 Comparative statics

Using comparative statics, this paper investigates the effect on local revenue collected (X^*) of an exogenous change in grants (K), the proportion of revenue shifted to the common fund (α) and the parameter of the component which depends on local revenue (b). In other words, how the equilibrium level of revenue changes with a change in a parameter. On the one hand, an increase in K is expected to have an income effect that increases total revenue (Z=(1-α)X + G), decreasing the marginal utility ($f'(Z)$) thus decreasing the local revenue collected. On the other hand, an increase in α (b) is expected to have two effects: first, a decrease (increase) in total revenue (Z = (1-α)X + K + $\beta(X;b)$), which increases (decreases) the marginal utility ($f'(Z)$), and then increases (decreases) the local revenue collected; second, a decrease in the marginal benefit of collecting revenue (1-α + β'(X;b)) which decreases the local revenue collected. As a result, the effect of α on X would be ambiguous and the effect of b would be negative.

The impact on X^* of a change in K is:

$$\frac{\partial X^*}{\partial K} = \frac{-f'' \times [(1-\alpha) + \beta'(X;b)]}{[(1-\alpha) + \beta'(X;b)]^2 \times f'' + f' \times \beta'' - e''} < 0 \tag{6}$$

The denominator corresponds to the SOC and therefore is negative, while the numerator consists of $-f'' > 0$, and $[(1-\alpha) + \beta'(X;b)] > 0$ by FOC, so it is positive. Thus, the relationship between local revenue collected and grants would be unambiguously negative, because the grants have a negative income effect.

The impact on X^* of a change in α is:

$$\frac{\partial X^*}{\partial \alpha} = \frac{-f'' \times [(1-\alpha) + \beta'(X;b)]X^* + f'}{[(1-\alpha) + \beta'(X;b)]^2 \times f'' + f' \times \beta'' - e''} \lesseqgtr 0 \tag{7}$$

In this case, the denominator is again the SOC and therefore is negative. The numerator has a first term ($-f'' \times [(1-\alpha) + \beta'(X;b)]X^*$) which is negative and a second term (f') which is positive. If $| -f'' \times [(1-\alpha) + \beta'(X;b)]X^* | < f'$, then $\frac{\partial X^*}{\partial \alpha} < 0$. Otherwise, $\frac{\partial X^*}{\partial \alpha} > 0$.

The decomposition of the local revenue change due to α change in the two effects described above can be explained in the following way:

$$\frac{\partial X^*}{\partial \alpha} = \frac{\partial X^*}{\partial \alpha}(\text{with constant total revenue}) + \frac{\partial X^*}{\partial \alpha}(\text{due to total revenue change}) \tag{8}$$

where $\frac{\partial X^*}{\partial \alpha}(\text{due to total revenue change}) = \frac{\partial X^*}{\partial \text{Total revenue}} \frac{\partial \text{Total revenue}}{\partial \alpha}$

An exogenous change in total revenue can be produced by a change in K, that is, $\frac{\partial X^*}{\partial K} = \frac{\partial X^*}{\partial \text{Total revenue}} \frac{\partial \text{Total revenue}}{\partial K} = \frac{\partial X^*}{\partial \text{Total revenue}} \times (1)$. Since $\frac{\partial \text{Total revenue}}{\partial \alpha}$ = -X , eq. (8) can be written as:

$$\frac{\partial X^*}{\partial \alpha} = \frac{\partial X^*}{\partial \alpha}(\text{with constant total revenue}) + \frac{-f'' \times [(1-\alpha) + \beta'(X;b)]}{[(1-\alpha) + \beta'(X;b)]^2 \times f'' + f' \times \beta'' - e''}(-X^*) \tag{9}$$

Then $\frac{\partial X^*}{\partial \alpha}(\text{with constant total revenue}) = \frac{f'}{[(1-\alpha)+\beta'(X;b)]^2 \times f'' + f' \times \beta'' - e''}$, that is, the compensated change in X^* due to a change in α.

Finally, the impact on X^* of a change in b is:

$$\frac{\partial X^*}{\partial b} = \frac{-f'' \times [(1-\alpha) + \beta'(X;b)] \frac{\partial \beta}{\partial b} - f' \frac{\partial \beta'}{\partial b}}{[(1-\alpha) + \beta'(X;b)]^2 \times f'' + f' \times \beta'' - e''} < 0 \tag{10}$$

In this case, the denominator is again the SOC and therefore is negative. The numerator has a first term $(-f'' \times [(1-\alpha) + \beta'(X;b)] \frac{\partial \beta}{\partial b})$ which is positive and a second term $(-f' \frac{\partial \beta'}{\partial b})$ which is also positive.

This effect can be decomposed as in eq. (8):

$$\frac{\partial X^*}{\partial b} = \frac{\partial X^*}{\partial b}(\text{with constant total revenue}) + \frac{\partial X^*}{\partial b}(\text{due to total revenue change}) \tag{11}$$

Since $\frac{\partial \text{Total revenue}}{\partial b} = \frac{\partial \beta}{\partial b}$, eq. (11) can be written as:

$$\frac{\partial X^*}{\partial b} = \frac{\partial X^*}{\partial b}(\text{with constant total revenue}) + \frac{-f'' \times [(1-\alpha) + \beta'(X;b)]}{[(1-\alpha) + \beta'(X;b)]^2 \times f'' + f' \times \beta'' - e''}(\frac{\partial \beta}{\partial b}) \tag{12}$$

Then $\frac{\partial X^*}{\partial b}$(with constant total revenue) $= -\frac{f' \frac{\partial \beta'}{\partial b}}{[(1-\alpha)+\beta'(X;b)]^2 \times f'' + f' \times \beta'' - e''}$, that is, the compensated change in X^* due to a change in b.

The empirical analysis of this paper focuses on the effect of exogenous variation in grants (the income effect). In any case, as α and b show little variability in the data, it is difficult to identify the effects due to changes in those parameters.

3 Local governments and intergovernmental grants in Chile

Chile is a unitary country organized territorially and politically into 15 regions and 345 municipalities, characterized by a high territorial heterogeneity (Valenzuela, 2008). Local governments in Chile, known as municipalities, obtain revenue from the following sources:

1. Tax Revenue
    - Property taxes
    - Municipal licenses
    - Vehicle registration fees
    - Taxes on gambling
    - Mining and aquaculture licenses
2. Municipal Rights (concessions, licenses, service charges)
    - Waste removal
    - Other rights (drivers licenses, urbanization and construction permits, provisional licenses, vehicle transfers, sales of goods, use of public spaces, advertising in public spaces, etc.)
3. Fines and interest
4. Municipal Common Fund (Fondo Comn Municipal, or FCM)

5. Transfers and Competitive Funds from the Office of the Undersecretary of Regional Development (Subsecretaría de Desarrollo Regional, or SUBDERE)
   - Urban Improvement and Municipal Equipment Program (Programa de Mejoramiento Urbano y Equipamiento Comunal, or PMU)
   - Neighborhood Improvement Program (Programa de Mejoramiento de Barrios, or PMB)
   - National Fund for Regional Development (Fondo Nacional de Desarrollo Regional, or FNDR)
6. Transfers from other ministries
   - Governmental Competitive funds (Fondos Concursables)
   - Central government programs
7. Transfers for mandated or delegated services
   - Education
   - Primary Health

Municipal tax revenues consist of taxes on assets. Property taxes, which are set by the central government at the national level, are the main source of tax revenue. The central government also determines which properties are tax-exempt[13]. The tax base corresponds to the tax assessment of each municipalitys properties carried out by the Internal Revenue Service (Servicio de Impuestos Internos, or SII) every five years. This tax revenue is collected by the national Treasury while municipalities collect revenues for municipal licenses and vehicle registration fees. For the former, municipalities can set the license rate within a range[14] with the tax basis corresponding to the business' own capital (capital propio). Businesses must pay taxes to the municipality in which they are located. The rate of the vehicle registration fee is set by the SII according to the vehicle value, although

[13]According to Horst (2009) 80% of housing is exempt.

[14]The tax rate must be between 0.25 and 0.5%, and the tax amount may not be less than 1 UTM or greater than 8.000 UTM.

the vehicle owner may pay the registration fee in any municipality[15]. Municipalities are required to contribute part of the revenue collected from these first three types of tax. Because taxes on gambling and mining and aquaculture licenses became municipal revenue sources after 2008, they are not included in this research.

Municipal rights (derechos municipales) correspond to the funds collected for the use of municipal goods, services or institutions by third parties. Waste removal is the most important municipal right, due to its magnitude and complexity.

Laws related to municipal revenues provide municipalities with different tools to increase the revenue they collect, both when they are responsible for collection and when they are not. For instance, municipalities can improve services provision to taxpayers. In the case of property taxes, municipalities are responsible for developing the urban master plan, updating property assessment surveys (cadastre)[16] and delivering information on building permits, final receipts and audits conducted by municipal works management to the SII. Today, 60 municipalities have Municipal Agreement Offices (Oficinas de Convenio Municipal, or OCM) operated by the SII where community members can carry out property-related transactions[17] in that municipality. Moreover, municipalities can carry out administrative and judicial collection of taxes and rights which are unpaid or in arrears. In addition, alternatives source of revenue exist which do not depend on central government decisions but on proper administration and governance.

The FCM is a horizontal, redistributive unconditional grant. These categories of revenue (tax revenues, municipal rights and FCM) represent in the municipal budget what is referred to as "own resources" (recursos propios). These resources, by law, belong to the Chilean municipalities. As will be discussed below, my research focuses on these categories.

Resources from SUBDERE mainly finance investment projects and are competitive funds which municipalities must apply for. They are administered by regional governments, that is, regional governments determine which projects will be developed and in what order.

[15] Since 2007, the Ministry of the Interior (Ministerio del interior) has prohibited municipalities from advertising to attract taxpayers and allows them only to deliver information about places and hours for making tax payments.

[16] Scarpaci and Irarrázaval, 1994

[17] The transactions that can be requested are modification of a property assessment and obtaining a prior history for the tax appraisal statement.

Transfers from the PMU and PMB are included in municipal financial statistics.

Transfers from other ministries correspond to funds for specific projects and programs and are not administered as part of the municipal budget because their allocation depends on the central government.

Transfers for education consist of a per-student subsidy (voucher) for public schools which are managed by local governments. Transfers for primary healthcare are funds directly allocated to municipalities which operate primary healthcare facilities, based on a per capita formula. Transfers for education and for primary health are specific-purpose funds, that is, they are intergovernmental transfers specifically allocated to these areas and are treated separately from the municipal budget.

SUBDERE defines Permanent Own Revenues (Ingresos Propios Permanentes, or IPP) as those revenue items which are generated by local sources and which remain with the municipality. That is, revenue from property taxes, vehicle registration fees and municipal licenses which is not shared with the FCM, and revenue from municipal rights, fines and other fees. In this context, the first three represent around 65% of the IPP[18][19]. The FCM uses this definition for redistributing resources.

This paper focuses on total tax revenue and municipal rights as the definition of local revenue; in other words, the revenue included in the IPP definition plus the resources shifted to the FCM. There are two reasons for adopting this definition: first, IPP collection and resources shifted to the FCM both depend heavily on the fiscal effort of the municipalities. Second, since transfers and competitive funds from SUBDERE and other ministries or for delegated or demandated services are generally not recorded in municipal Budget Implementation Balances[20], there is little public information about their magnitude and evolution. Thus, for this study local revenue is defined as tax revenue, municipal rights and fines and interest.

[18]Specifically, property taxes which are not shared with the FCM represent around 28% of the IPP, vehicle registration fees not shared with the FCM represent around 8% of the IPP and municipal licenses not shared with the FCM represent around 28% of the IPP.

[19]Since 2008, this definition has included taxes on gambling and mining and aquaculture licenses.

[20]The municipalities report their revenues accounts in Budget Implementation Balances (Balances de Ejecución Presupuestaria, or BEP).

Because of this local revenue structure and the highly geographically concentrated nature of Chilean tax bases, there are dramatic differences among municipal revenues. In 2007, considering property taxes, municipal licenses and vehicle registration fees, just 36 municipalities, representing 10% of all municipalities, collected 70% of revenue, while more than half of the municipalities collected just 5% of revenue (Horst, 2009). Thus, there is a need for redistribution of resources among governments at the same level.

Revenue redistribution among municipalities is channeled by the FCM[21] which was created in 1979[22]. According to the Municipalities Division of SUBDERE, FCM constitutes the main source of revenue of Chilean municipalities. In 2007, its relative share of the total municipal budget, aside from external resources[23] was 32%, whereas the share of IPP was close to 40%.

FCM is self-financed; that is, all municipalities contribute resources and in turn, these resources are distributed among all municipalities. Certain municipalities provide a greater amount of funding than that which they receive (that is, the net grant is negative; these are known as net contributors) while others receive more than they contribute (that is, the net grant is positive; these are called net receivers). Given the unequal distribution of income, in 2007, 50 municipalities were net contributors and 295 were net receivers.

The resources transferred from municipalities to the FCM represent proportions of certain tax revenue, whereas the resources received are determined by a formula which considers variables representing fiscal capacity and fiscal need. The FCM composition and distribution formula underwent several changes from 1990 to 2007. Table 1 presents the proportion of different local revenues which have been provided by municipalities to FCM over that period. In 2006, resources from property taxes represented 50% of the total fund, while revenue from municipal licenses represented close to 12% and vehicle registration fees close to 20%.

[21]According to Chile's Political Constitution, Article 22, the FCM is a "mechanism of solidarity redistribution of own revenues among the country's municipalities". According to Law No 18,695, The Organic Constitutional Law of Municipalities, the aim of the FCM is "to ensure achievement of the goals of the municipalities and their proper functioning".

[22]Law Decree No 3,063.

[23]Excluding resources from the FNDR, transfers from other ministries and transfers for delegated or demandated services.

The distribution formula results in a distribution coefficient for each municipality; this coefficient represents the proportion of the total fund that corresponds to each municipality. To calculate this coefficient, first a coefficient is calculated for each of the components included in the formula. Finally, the weighted sum of the component coefficients is calculated, resulting in the distribution coefficient. That is, if the distribution formula is comprised of J components, the distribution coefficient of municipality i is:

$$\text{Distribution coefficient}_i = \sum_{j=1}^{J} \text{component weight}_j \times \text{component coefficient}_{ji}$$

During 1990-2007, two distribution coefficients are considered: one used to distribute 90% of the fund and the other used to distribute the remainder (10%). The 90% coefficient was calculated every three years and aimed at redistributing revenues in a stable fashion, whereas the 10% distribution coefficient was calculated annually and designed to encourage efficiency and for coping with emergencies. Table 2 shows the period covered by each 90% distribution coefficient over the years 1990-2007. The components included in the 90% distribution coefficient are the following:

1. Number of municipalities: this component corresponds to $\frac{1}{\text{No Municipalities}}$. The idea behind this component is to distribute resources equally.

2. Number of inhabitants (population): the larger the population, the higher the component's coefficient. The formula of this component's coefficient takes into consideration the population projection provided by the National Institute of Statistics (Instituto Nacional de Estadísticas, or INE) on June 30 of the penultimate year of the immediately preceding triennium, plus the estimated floating population[24]. The projected population is updated with data from the population censuses which take

[24]The floating population is included only if a municipality is categorized as a summer resort (balneario), that is, it receives a significant flow of temporary residents at certain times of the year. This categorization is done by SUBDERE. Summer resort municipalities may be classified as touristic municipalities or municipalities with social tourism. In a touristic municipality, the floating population is estimated as four-thirds of the municipality's total properties on December 31 of the penultimate year of the immediately preceding triennium. In municipalities with social tourism, the floating population is estimated as eight-thirds of the municipality's total properties on December 31 of the penultimate year of the immediately preceding triennium.

place every 10 years. Between 1990 and 2007, two censuses were applied, in 1992 and 2002. Table 3 presents the data used in every triennium.

3. Exempt properties: the higher the number of tax-exempt properties with respect to the total, the higher the component's coefficient. The formula for this coefficient considers the exempt properties reported by the SII on December 31 of the penultimate year of the immediately preceding triennium. Table 4 presents the data used in every triennium.

4. Relative poverty (percentage of people living in poverty within the municipality, compared to the overall percentage for the country): the higher the relative poverty, the higher the component's coefficient. From 1996 through 2007, this component's coefficient is based on a municipal poverty index estimated by SUBDERE. This index considers mother's schooling and height-age deficit of children between 0 and 6 years[25]. Table 5 presents the data used in every triennium. Since 2007, this component includes the poverty index reported by the Socioeconomic Identification Survey (Encuesta de Caracterización Socioeconómica, known as CASEN).

5. IPP per capita (IPPP): the higher the IPPP, the lower the component's coefficient. For each municipality, this component's coefficient includes the average IPPP of the three years prior to the final year of the immediately preceding triennium[26]. In this paper, this average is referred to as the "IPPP used in the distribution formula" (or IPPPd). The population considered in this component is adjusted by the floating population. Table 6 presents the data used in every triennium. This component works if the IPPPd of a municipality is lower than the national average IPPPd ($\overline{IPPPd}_N$). More formally, the IPPP component has the following rule:
If $IPPPd_i > \overline{IPPPd}_N$, then IPPP component's coefficient$_i = 0$.
If $IPPPd_i \leq \overline{IPPPd}_N$, an index ($IPPPindex_i$) is calculated for municipality i using the following formula:

$$IPPPindex_i = (\overline{IPPPd}_N - IPPPd_i) \times \text{Population}_i \tag{13}$$

[25]This information is reported by the National Education and Scholarships Board (Junta Nacional de Escolaridad y Becas, or JUNAEB).

[26]From 1990 to 1995, only the IPPP of the year preceding the final year of the immediately preceding triennium is included.

Then, the IPPP component's coefficient for municipality i is:

$$\text{IPPP component's coefficient}_i = \frac{\text{IPPP index}_i}{\sum_{i=1}^{M} \text{IPPP index}_i} \tag{14}$$

where $i = 1, 2, ..., M$ with M = number of municipalities with $IPPPd_i \leq \overline{IPPPd}_N$.

In the latter case, the size of the IPPP component's coefficient is proportional to the difference between the IPPPd and its national average.

Finally, Table 7 presents the weights of each component included in the 90% coefficient of distribution. For instance, the grant received by municipality i from the distribution of 90% of the common fund (FCM) for the 1996-2007 period is the following:

$$\begin{aligned} \text{FCM90\% grant}_i = 0.9 \times FCM \times [&0.1 \times (\text{equal parts component's coefficient}_i)+ \\ &0.15 \times (\text{population component's coefficient}_i)+ \\ &0.3 \times (\text{non taxable property component's coefficient}_i)+ \\ &0.3 \times (\text{relative poverty component's coefficient}_i)+ \\ &0.35 \times (\text{IPPP component's coefficient}_i)] \end{aligned} \tag{15}$$

Every time the distribution coefficients were calculated during this period, some municipalities received a lower amount of funds because they obtained a lower distribution coefficient. To offset this, the central government passed laws to provide them with additional resources from the same fund.

Until 1995, the 10% distribution coefficient was known as the "coefficient of annual participation due to lower resources for adjusted operating expenses" and was intended to cover possible operational deficits in some municipalities[27]. Starting in 1996, this annual coefficient was divided in two: 50% to promote efficiency in municipal management and

[27] That is, to finance personnel, goods and services expenditures. In some circumstances, it could finance investment, transferred services such as healthcare and education, emergencies, etc.

50% for emergency expenses[28][29].

Since 2008, there has been only one distribution coefficient for the 100% of the common fund which is calculated once per year. This decision was made on the basis that having one instrument (the FCM) with multiple objectives (redistribution, emergencies and efficiency) was a structural weakness of the system (Valenzuela, 2008).

To conclude, Chilean municipalities are not able to improve revenue collection without having to engage in a costly process which requires skilled personnel and databases to manage available local resources. In Chile, the mechanism for redistributing revenue is horizontal and the resources contributed by each municipality are in proportion to its local revenue. With respect to distribution of the FCM, on the one hand, all municipalities receive FCM grants, enabling measurement of the income effect of redistributive grants. On the other hand, the resources received depend on local revenue, which increases the opportunity cost of efficient tax collection. The expectation is that the FCM would encourage "fiscal laziness" not just due to an income effect, but also because of the design of the redistributive horizontal grants used in Chile[30].

4 A motivating result

Before the IV estimation, the effect of having an IPPPd which is lower than the national average (treatment) on per capita local revenue (outcome) was analyzed using a difference-in-difference (DID) estimator. Apart from its intuitive simplicity, the DID estimator enables a solution to the problem of omitted variables. First, having an IPPPd which is lower than the national average can be considered a natural experiment (random), because municipalities whose IPPPd is just below the national average and those that

[28] The coefficient of the former had the following components and weights: 30% for real increase of IPPP, 10% for increased SIMCE test scores, 10% for annual expenditure on staff training relative to total annual personnel expenditures, 15% for operational surplus, 10% for spending to benefit the community, 10% for growth of real investment per capita, 10% for not owing pension payments to municipal workers. The formula of the latter had the following components and weights: 30% for financing emergency prevention projects, 10% for reduction in IPPP, 20% for population growth, 20% for coping with natural catastrophes and 20% for offsetting changes in the distribution coefficients.

[29] The emergency coefficient was used several times to offset changes in the distribution coefficient.

[30] My future research will explore the effects of the grant's design.

are just above the national average have a similar IPPPd and because they do not know what the national average is, being above or below it is essentially accidental. Then, they would show few systematic differences in any other pre-treatment variable. Second, the DID estimator enables controlling for temporal trend in the outcome variable or for the effect of events, other than the treatment, which occurred from one period to the next.

Treatment means that a municipality has a positive IPPP component coefficient and in the previous triennium it did not. If all other variables are kept constant, to be treated would mean that the grant received has increased[31]. The control group consists of municipalities that never have a positive IPPP component coefficient. Moreover, their IPPPd are at most one-third of a standard deviation higher than the national average IPPPd of the year in which treated municipalities do not have a positive IPPP component coefficient. This definition guarantees that municipalities which are very different are not compared in terms of their revenue and revenue determinants.

Since 1993, for each year in which the 90% distribution coefficient changed, it was possible to identify treated and control municipalities, because the IPPPd of two consecutive trienniums was known. So, the DID estimator was estimated for four periods[32].

To obtain the DID estimator, the following model was estimated:

$$\overline{X}_i = \alpha + \beta_1 t + \beta_2 g + \beta_3 tg + \epsilon_i \tag{16}$$

where $\overline{X}_i$ is the triennial average per capita local revenue for municipality i, the dummy variable g equals one for those in the treatment group and is zero otherwise and t denotes a dummy variable for the second triennium.

The dummy t captures aggregate factors that affect local revenue over time in the same way for both groups. The dummy g captures possible differences between the treatment and control groups before the second triennium begins. The coefficient of interest β_3, the

[31]The treatment group is not defined as municipalities with an IPPP component coefficient equal to zero whose IPPP component coefficient in the previous triennium had been grater than zero, because in this case being treated does not mean that the grants decreased. This is because the common fund grew steadily over the 1990-2007 period and, as mentioned in section 3, municipalities which received smaller grants were sometimes compensated with additional resources.

[32]The number of municipalities in each group for each period is presented in Appendix A.

DID estimator, multiplies the interaction term tg, which is simply a dummy variable equal to one for those observations in the treatment group in the second triennium.

The OLS estimator, $\hat{\beta}_3$, can be expressed as:

$$\hat{\beta}_3 = (\overline{X}_{11} - \overline{X}_{10}) - (\overline{X}_{01} - \overline{X}_{00}) \tag{17}$$

where $\overline{X}_{00}$ denotes the average per capita local revenue for the control group in the first triennium, $\overline{X}_{01}$ is the average per capita local revenue for the control group in the second triennium, $\overline{X}_{10}$ denotes the average per capita local revenue for the treatment group in the first triennium, and $\overline{X}_{11}$ is the average per capita local revenue for the treatment group in the second triennium.

Prior to presenting the results, Figure 1 shows the average local revenue measured at base 100 of each group (control and treatment) for the four three-year periods. The vertical red line shows the end of a triennium and the beginning of the next triennium. This graphical analysis provides a first indication of whether a treatment effect exists; in other words, after receiving treatment, municipalities collect revenue which is lower than that of the control municipalities and lower than their own revenue had been in the past.

Figure 1 shows that for the three first periods, the treated municipalities' local revenue grows more slowly than it grew in the previous triennium in which they did not have a positive IPPP component coefficient, and also more slowly than the local revenue of the control municipalities. This effect is stronger in the second year of the second triennium.

The results of DID estimation, presented in Table 8, suggest that receiving the treatment has a negative effect on per capita local revenue. Specifically, if a municipality has a positive IPPP coefficient, its local revenue decreases between Th$ 2.84 and Th$ 4.93. However, there are no statistically significant estimates, which could be due to the sample size (180 municipalities) or the absence of other covariates. The last column of Table 8 presents the proportion that represents this effect on average local revenue for the treatment group in the first triennium.

Appendix B presents the DID estimator when eq. (16) is estimated using only the per capita local revenue of the last year of the first triennium and the first year of the second triennium, rather than the average per capita local revenue of each triennium. In this case, the effect is negative but is not statistically significant, and it is smaller than that presented in Table 8, indicating that the response of municipal revenue to grants is greater in the long term than the short term.

5 Identification strategy and empirical model

5.1 Sources of endogeneity

As mentioned in the first section, the endogeneity of intergovernmental grants is a common problem for fiscal federalism's empirical literature. Grants have many potential sources of endogeneity. First, variation in grants could be explained by time variant or time invariant unobserved variables that influence local revenue. Fiscal capacity is an unobserved time variant variable that is positively correlated with local revenue collection but negatively correlated with grants. The community's willingness to pay taxes determines the collected revenue and the grants. Communities with a high willingness to pay taxes will be able to collect more revenue and will thus receive lower grants. Therefore, grants are endogenous to local revenue and OLS estimates will produce downward-biased estimates of the causal effect of grants on local revenue.

Alternatively, municipalities with good governance and in which a significant fiscal effort is exerted by local authorities will collect high revenues[33]. In Chile, this kind of municipality will receive a larger grant due to the 10% distribution coefficient. Moreover, if a municipality receives a higher grant, the local authorities can manage those resources so that indirectly this management exerts a positive effect on local revenue. For example, if grants improve the quality or quantity of local public goods, communities might show greater willingness to pay taxes. In these cases where the unobserved variable's partial effect on local revenue is positive and unobserved variable and grants are positively correlated, OLS estimates of the causal effect of grants on local revenue could be biased upward.

[33] These variables could be considered time invariant during the period in which the local administration does not change.

A second source of endogeneity arises because of the equalization goal of the Chilean grants system, where municipalities that collect less local revenue and have lower fiscal capacity receive higher grants. This simultaneity problem or reverse causality will also produce downward-biased estimates. Moreover, if the distribution of resources is based on factors that discourage the exertion of more effort to increase local revenues, such as the non-taxable property and local revenue, the simultaneity problem is more significant.

Finally, local revenue is self-reported by the municipalities, so it could be mis-measured[34]. If this measurement error is systematically related with one or more explanatory variables, it could cause biases in OLS estimates. In this case, the measurement error is not independent of the grant amount reported by a municipality, because a municipality which receives a large grant is more likely to underreport its local revenue in order to appear to need the grants. This would produce a downward bias in OLS estimates (Wooldridge, 2001) of the causal effect of grants on local revenue. Thus, the estimates from an OLS specification would be biased due to an omitted variable problem, simultaneity problem or measurement error. Moreover, not only is it difficult to identify the different possible forms of endogeneity but also to know what will be the net bias of the OLS estimates.

5.2 Regression Kink Design (RKD)

The regression kink provides nonparametric identification of the average marginal effect of a continuous endogenous regressor which is a known, deterministic, but kinked function (policy rule) of an observed continuous assignment variable. It is similar to a regression discontinuity design (RDD) except that instead of exploiting a shift in levels, the regression kink design exploits a shift in slopes (Simonsen et al, 2010). The identification strategy used is based on the same condition for identification which is behind RKD, the main characteristics of which are described below. This subsection is based on Card, Lee and Pei (2009).

To understand this particular design, consider the model Y = y(B, V, W) where Y is an outcome, B is a continuous regressor of interest, V is another covariate that enters the

[34]FCM grants are self-reported too, but there are no incentives for misreporting these data. Moreover, the Treasury is responsible for distributing these resources.

model, and W is an unobservable, nonadditive error term. B is mechanically determined as a function of the assignment variable V which has a kink at $v = v_0$ (B= b(V)). There are observed random variables X which are determined prior to V, which in turn is determined prior to B. The idea is that if B exerts a causal effect on Y, and there is a kink in the deterministic relationship between B and V at $v = v_0$, then we should expect to see an induced kink in the relationship between Y and V at $v = v_0$. That is, it exploits the exogenous variation in the regressor of interest caused by kinked schemes. This corresponds to a sharp regression kink design.

Card et al. (2009) establish the conditions under which the RKD estimator identifies the "local average response" or, equivalently, the "treatment on the treated" parameter that is identifed in an ideal, randomized experiment. Thus, the parameter estimated using RKD is local.

Card et al. (2009) describe the assumptions and mechanics behind this strategy. The key condition for identification is the smoothness of the first derivative of the density of the assignment variable V conditional on W, which implies that agents must not have full control of the assignment variable, i.e., they cannot deterministically manipulate the value of the assignment variable used in the policy formula. If there is imprecise control over the assignment variable, every agent will have approximately the same probability of being just above or below the kink point, so the variation that this design isolates is randomized.

Another consequence of this smoothness condition is that the conditional distribution functions of observed covariates which are determined prior to the policy variable (X) should have continuous derivatives with respect to the assignment variable at the kink point. Thus, the validity of the RKD can be tested.

5.3 Identification strategy

This paper proposes using an instrumental variable (IV) estimator to identify an exogenous variation in FCM grants. The main estimating equation is:

$$X_{it} = \theta_0 + \theta_1 FCM_{it} + \delta f(IPPPd_{it}) + \theta_2 \alpha_{it}^{proptax} + \theta_3 \alpha_{it}^{munlic} + t_t + \mu_i + \epsilon_{it} \tag{18}$$

where X_{it} is per capita local revenue collected by the municipality i in year t, FCM_{it} is the per capita FCM grant received by municipality i in year t, $f(IPPPd_{it})$ is a 2nd, 3rd, 4th or 5th order polynomial function of the "IPPP used in the distribution formula" for municipality i in year t, $\alpha_{it}^{proptax}$ is the proportion of property tax revenue transferred from municipality i to the FCM in year t, α_{it}^{munlic} is the proportion of municipal license revenue shifted by municipality i to the FCM in the year t, t_t is the year fixed effect, μ_i municipality fixed effect, and ϵ_{it} is a random error term.

Specifically, the instrument used corresponds to the part of the grant which distributes the 90% of the FCM which is due to the IPPP component, referred to as IPPP grant (IPPPg). In other words, the IPPP grant for municipality i in year t is:

$$IPPPg_{it} = [\frac{\text{IPPP component coefficient}_{it}}{\text{90\%Distribution coefficient}_{it}}]\text{FCM90 grant}_{it} \tag{19}$$

where IPPP component coefficient$_{it}$ is determined by eq. (14), 90%Distribution coefficient$_{it}$ corresponds to the distribution coefficient of municipality i in year t that distributes the 90% of the FCM and FCM90 grant$_{it}$ is the part of the grant received by municipality i in year t due to the 90% distribution coefficient.

Figure 2 plots IPPP grants received by the municipalities against the IPPPd for a typical year (2003). The vertical line in the figure represents the national average. As the figure show, there is a well-defined cut at the national average. Municipalities with IPPPd above the national average have IPPP grants equal to zero, whereas those with IPPPd below the national average receive IPPP grants which are proportional to the difference between the IPPPd and the national average.

The identification strategy used here is based on the idea behind RKD[35]; in principle there is no reason to believe that municipalities which are just above the national average are different from municipalities which are just below it, except that the latter have positive IPPP grants and municipalities above the kink point receive IPPP grants equal to zero. This discontinuous shift in the slope of the relationship between the IPPP grant and the IPPPd arises from the IPPP component formula[36]. Thus, the identification strategy exploits this exogenous variation caused by the kinked scheme.

Moreover, since the IPPP component is updated every triennium, the variation caused by this kinked scheme over time can be exploited for every municipality. In other words, a municipality with IPPPd just below the national average could be just above the national average in the next triennium. This variation depends on the value of the national average, which is unknown to the municipalities and is also not under their full control. On average, in every triennium there are 30 municipalities that change position in relation to the national average. Figure 3 shows the frequency with which the municipalities have received an IPPP grant in the 1990-2007 time period. In the period studied, 33 municipalities never received an IPPP grant, 218 municipalities received an IPP grant in each of the 18 years and the remaining 89 municipalities received IPPP grants some, but not all, of the years.

This proposed instrument for FCM grants must satisfy two conditions. First, the instrument must be partially correlated with FCM grants. This condition is fulfilled because the IPPP grant is a component of the FCM grant. Second, the instrument must be uncorrelated with the unobservable random disturbance that would contain the omitted variable which would be correlated with the FCM grant. Since IPPP grants depend on the IPPPd (which is the IPPP of at least two years prior) and in turn the IPPPd might have a direct effect on current local revenue collection (as IPPPd is practically the lagged local revenue), it is needed to control for this variable in the estimations. Because the exact form of this direct effect is unknown, as flexible a functional form as possible is used (specifically, a 2nd order to 5th order polynomial functional form). As long as it is controlled for this variable, the residual variation in IPPP grants is driven by the shape of the IPPP component formula which is unrelated to unobserved determinants of

[35] In this setting, IPPPd is the assignment variable.

[36] Every year, close to 90 municipalities are within the interval [National average IPPPd $\pm$ 0.3$\times$standard deviation's IPPPd].

local revenue. This is especially true for municipalities whose IPPPd is near the national average. Moreover, this identification strategy purges the effect of local revenue from FCM grants.

The main difference between RKD estimation and this identification strategy is that in this setting the regressor of interest (FCM grant) is not determined by a kinked function of an assignment variable. Instead, the instrument proposed is related to an assignment variable through a kinked function. This setting could be referred as a "fuzzy" RKD.

Figure 4 plots the per capita local revenue collected by municipalities against the IPPPd. According to Dahlberg et al. (2008), this graphical analysis gives a first indication of whether the instrument will be able to identify any effects via the grant's component formula. A change is expected in the relationship between these two variables at the kink point of the national average IPPPd. Because the national average IPPPd changes every triennium, the IPPPd was centralized with respect to the corresponding national average, thus the national average IPPPd equals zero every year and it is possible to plot all data from the 1990-2007 period.

Figure 4 shows a positive relationship between local revenue collected and the centralized IPPPd[37]. For municipalities with negative centralized IPPPd, this relationship seems to have a different slope than those with positive standardized IPPP used in the distribution coefficient.

The condition for identification a causal effect is that municipalities cannot deterministically manipulate the value of the assignment variable (IPPPd). If they could, some municipalities might find it optimal to refrain from collecting an extra peso in order to receive IPPP grants. As a result, municipalities would be bunched just to the left of the kink point. However, in this setting this problem would be unlikely. Although municipalities have control of the IPPPd given that it corresponds to their revenue collected for the previous two years, they do not know the value of the national average IPPPd and thus are unaware if they are just to the left or to the right of the kinked point.

[37]In Figure 4, the green and red lines are the conditional expectation of local revenue collected based on a locally weighted regression of local revenue collected on centralized IPPPd.

To test this condition, the range of the IPPPd[38] was divided into suitable bins[39] and the histogram was plotted across these bins. Figure 5 plots the "frequency" of this variable using Th$3 bins, resulting in a graphical analysis with 10 bins on each side of the kink point 0. The histogram presents a drop between the 10^{th} bin (to the left of the kink) and the 11^{th} bin (to the right) which is similar in magnitude to the drops at other points (e.g., between the 5^{th} and 6^{th} bins, the 8^{th} and 9^{th} bins, or the 11^{th} and 12^{th} bins).

According to Card et al. (2009), it is possible to provide an estimate of a potential kink in the density of the assignment variable. Using collapsed data[40], the number of observations in each bin was regressed on polynomials of $(v_{bin} - k)$ and the interaction term $1[v_{bin} \geq k](v_{bin} - k)$, where v_{bin} is the centralized "IPPP used in the distribution formula" that corresponds to the center of each bin and k is the kink point (0). As suggested by Figure 5, up to 4^{th} order polynomial the coefficient on the interaction term is statistically insignificant (a t-statistic between 0.27 and 1.66)[41][42].

The first stage estimating equation is:

$$FCM_{it} = \gamma_0 + \gamma_1 IPPPg_{it} + \phi f(IPPPd_{it}) + \gamma_2 \alpha_{it}^{proptax} + \gamma_3 \alpha_{it}^{munlic} + t_t + \mu_i + \eta_{it} \quad (20)$$

where FCM_{it} is the per capita FCM grant received by municipality i in year t, $IPPPg_{it}$ is the IPPP grant corresponding to the municipality i in year t, $f(IPPPd_{it})$ is a 2nd, 3rd, 4th or 5th order polynomial function of the "IPPP used in the distribution formula" for municipality i in year t, $\alpha_{it}^{proptax}$ is the proportion of property tax revenue transferred by municipalities to the FCM, α_{it}^{munlic} is the proportion of municipal licenses revenue shifted

[38]As in Figure 4, the assignment variable is the centralized IPPP used in the distribution formula. This is because the kink point is the same every year, which makes it possible to work with all the data together.

[39]Following a procedure presented by Lee and Lemieux (2009), I chose the bin size that passes the test they suggest.

[40]As with Figure 5, I collapsed the data into equal-sized bins of width Th$ 3. The collapsed data set contains 20 observations because I restricted the sample.

[41]Using Imbens' regression discontinuity estimator with optimal bandwidth, with which the point estimate and standard error for the RD are calculated, the drop between the 10^{th} bin (to the left of the kink) and the 11^{th} bin (to the right) was tested to determine if it is statistically significant. The point estimate for RD was found to be statistically insignificant.

[42]For each triennium, testing was done for kinks in the density of standardized IPPPd. There is no robust evidence that the density of the assignment variable is not continuously differentiable at the kink point.

by municipalities to the FCM, t_t is the year fixed effect, μ_i municipality fixed effects, and η_{it} is a random error term.

The exclusion restriction required for the instrument to be valid is that the functional form of the direct relationship between local revenue and the IPPPd is not the same as the relationship between the IPPPd and IPPPg, i.e., the IPPP grant formula. If we allow local revenue to be a kinked function of the IPPPd as the IPPP grant is, that is, the functional form illustrated in Figure 2, it would be impossible to distinguish between changes in local revenue due to a change in IPPPd or a change in grant.

The relevance of the excluded instrument will be examined with the t value of the coefficient of IPPPg in the first stage estimates and the weak identification will be tested with the Kleibergen-Paap Wald rk F statistic.

5.4 Other covariates

Municipality fixed effects are included in the regression because they control for time-invariant unobserved municipal characteristics which may be correlated with the observed independent variables. Year fixed effects are included in the regression because they control for common trends such as changes in legislation affecting all municipalities equally or economic growth.

Finally, the proportions of property tax revenue and municipal license revenue that are shifted to FCM are included in the regression. Because FCM grants, rather than net grants (i.e., the difference between grants received and shifted resources) are the regressor of interest, these variables can control for shifted resources. Only the proportions for property taxes and municipal licenses are considered, while the vehicle registration fee is excluded, because the proportion of vehicle registration fee revenue shifted to FCM is the same for all municipalities and only undergoes changes over time which are controlled by year fixed effects. On the other hand, the proportions of property tax revenue and municipal licenses shifted to the FCM are different for the four higher-revenue municipalities and undergo at least one change over the 1990-2007 time period.

6 Data

To identify the effect of FCM grants on local revenue, an annual dataset for 340 Chilean municipalities for the 1990-2007 time period was used. The dataset includes all municipalities but some were identified as outliers because in some years they present an observation of per capita local revenue that does not belong to the same distribution as their revenue[43].

Table 10 presents descriptive statistics for the dependent variable[44] (per capita collected local revenue, X, and its decomposition in the different kinds of revenue: proptax, munlic, vehreg, orev), the grants variable (FCM[45], IPPP grant (IPPPg) and net grants[46], all measured per capita), the variable used in the control functions (IPPPd), the SUBDERE's revenue measure (IPPP), the proportions of local revenue shifted to the FCM (property taxes, municipal permits, vehicle registration fees, all decimalized) and socioeconomic variables used to control and test robustness (poverty rate, population, exempt properties, SIMCE, construction permits).

The outcome variable (per capita local revenue, X) exhibits considerable variation and large differences between 5^{th} quintile municipalities and 95^{th} quintile municipalities, which is a reflection of the fiscal inequality that exists among Chilean municipalities. The negative value of the net grants for municipalities in the 5^{th} quintile reflects the fact

[43]To define an outlier municipality, I used the coefficient of variation of per capita local revenue of each municipality for the 1990-2007 time period. A municipality is an outlier if the variation coefficient of its per capita local revenue is greater than one. Using this definition, five municipalities were categorized as outliers. The per capita local revenue series of these five municipalities and their variation coefficients are reported in Table 9.

[44]For the 1990-2007 time period it was not possible to obtain another reliable measure of fiscal effort, either a relative measure regarding fiscal capacity or a relative measure of the resources for collection. Covering this period is very important because it enables exploitation of the variation within a municipality.

[45]The regressor of interest, FCM_{it}, corresponds to the resources received by the municipalities, that is, the resources that municipalities report to SUBDERE as received. These resources are not necessarily equal to what would correspond according to the distribution formula. This difference could be due to poor accounting by municipalities or to discounts for debt or other agreements. The following section also considers the FCM grant according to the distribution formula as regressor (FCM2).

[46]For estimating net grants, only the corresponding proportion of property taxes, municipal licenses and vehicle registration fees were considered because there is no information for other sources of revenue (vehicle transfer tax and traffic fines). In 2008, both sources of revenue represented only around 4% of the total.

that the FCM is self-financed.

SUBDERE's Division of Municipalities provided the financial data for the 1990-2001 time period, whereas the National System of Municipal Information (Sistema Nacional de Información Municipal, or SINIM) provided the information for 2002-2007. The SINIM, which is administered by SUBDERE, receives financial information from the municipalities. The grant variables measured per capita use the projected population for the 1990-2007 time period, based on all censuses until 2002. All financial variables are measured in Th$ 2007.

SUBDERE provides official reports of the "IPPP used in distribution formula" (IPPPd). Differences between per capita local revenue and the IPPPd, besides the temporal element, are due to the definition of local revenue and the way the population is measured. For per capita local revenue, the projected population over the 1990-2007 time period was considered, based on censuses through 2002, whereas the IPPPd includes the population noted in Table 3, that is, projected population based on the latest censuses, which changes depending on the year the distribution coefficient was estimated. As mentioned in section 3, local revenue is considered to be the IPP definition plus the resources shifted to FCM, while IPPPd uses the IPP definition.

Finally, the poverty data is provided by CASEN. For the years in which this information is not available, the value of the preceding year was assigned. Municipalities for which this information was not available were assigned the regional poverty data. SIMCE data was obtained from the web site of the Ministry of Education and construction permit data was obtained from the Urban Observatory (Observatorio Urbano) web site of the Ministry of Housing and Urbanism.

7 Results

7.1 IV results

This section presents OLS estimates, the first stage estimates and the IV estimates, following the specifications given in Eq. (18) and Eq. (20).

Columns (1)-(3) of Table 11 present OLS estimates. Column (1) presents a parsimonious model which only includes municipality fixed effects and year fixed effects. Column (2) includes socioeconomic variables such as population and poverty and column (3) also includes 2^{nd} order polynomial function of "IPPP used in the distribution formula". The first two OLS estimates are not statistically significant, that is, there is no relationship between local revenue collected and FCM grants; but when controlling for polynomial function of IPPPd these estimates are 0.02. When the order of the polynomial function is increased, the results are between 0.02 and 0.04.

Columns (4)-(11) in Table 11 show IV estimates. Columns (4) to (7) present the parsimonious model and different orders of the polynomial function, which increase from 2 to 5. Columns (8) to (11) present the model which includes socioeconomic variables and the different order of the polynomial function.

The first stage estimates from the IV estimation (i.e., estimation of Eq. (20)) are at the bottom of Table 11. Examining t-values for the IPPP grant formula and the F statistic's values, we test whether the excluded instrument is relevant. The results show that IPPP grants have a positive and statistically significant effect on FCM grants, regardless of the order of the polynomial function and the inclusion of socioeconomic variables. Increasing the number of the polynomial order increases the point-estimate somewhat and the t-values for the IPPP grant. In conclusion, the IPPP grant is correlated with the FCM grant received by municipalities; hence, the instrument is relevant.

All IV estimates in Table 11 are negative and statistically significant at 1% and 5%. In other words, the IV estimates fall within the interval between -0.153 and -0.189. An increase of one standard deviation in per capita FCM grants is associated with a decrease between 0.25 and 0.32 standard deviations in per capita local revenue. These results imply that the effect of an increase in FCM grants on local revenue is also economically significant. This effect is attributable to the income effect of grants. This estimation is local, which may be interpreted as the expected effect of grants on local revenue for municipalities whose revenue is close to the national average.

The results are not significantly affected by the order of polynomial function or socioeconomic variables[47]. According to Dahlberg et al. (2008), the inclusion of additional observed covariates is an alternative test for the exogeneity of the instrument. If the results are insensitive to the inclusion of additional observed covariates, they are also insensitive to the inclusion of other (potentially unobserved) covariates. The IV estimates are larger, in absolute values, than the OLS estimates, suggesting that the net bias is positive.

Without controlling for municipalities fixed effects, i.e., simply exploiting the exogenous variation between municipalities and not the exogenous variation within each municipality over time, the effect of the FCM grants on local revenue collected is also negative, close to -0.12.

Table 12 and Table 13 present the IV estimates with the specifications given in Eq. (18) and Eq. (20), but the dependent variable corresponds to different kinds of local revenue which comprise the total local revenue collected, that is, property taxes, municipal licenses, vehicle registration fees and revenue other than tax revenue. When the FCM grant increases by one standard deviation, municipal license revenue decreases by almost 0.5 standard deviations and tax property revenue decreases by 0.33 standard deviations. Vehicle registration fees[48] and other revenue do not change. Thus, municipal licenses are more sensitive than property tax revenue. The greater sensitivity of municipal licenses compared to property taxes could be due to the fact that the municipalities are responsible for collecting the former while for the latter, municipalities only provide updated information on property values and support the SII's efforts, but do not take part in the tax collection process.

The fact that vehicle registration revenue and the other revenue are not affected by changes in FCM grants may be due to strategic interaction among governments, which has not been considered in this model[49]. The taxpayer must pay property taxes and municipal licenses in the municipality where he\ she resides, while vehicle registration fees and some other

[47]Different specifications were estimated, controlling for different orders of polynomial functions and the socioeconomic variables which are not presented in this paper.

[48]Note that vehicle registration fees would increase by 0.25 standard deviations if the polynomial order is five.

[49]According to Brueckner (2003), strategic interaction among governments has recently become a major focus of theoretical work in public economics. In the tax competition literature, governments levy taxes on a mobile base. When the number of jurisdictions is small, these taxes are chosen in strategic fashion, taking into account the inverse relationship between a jurisdiction's tax rate and its base.

sources of revenue may be paid in any municipality. Thus, in the latter case, assuming a relatively constant tax base, a municipality's revenue collection is affected by collection elsewhere. In other words, if the distribution of tax bases among jurisdictions is affected by the total tax collection by all of them, when a municipality exerts significant effort to collect revenue, this lowers the available tax base for other municipalities. On the contrary, when a municipality exerts little effort to collect revenue, the available tax base for other municipalities is greater. With this kind of strategic interaction among local governments, the income effect of an increase in the FCM grant may be offset. This is because if some municipalities collect lower revenue, even though another municipality has not made a greater effort at collection, the available tax base is more extensive and it can increase its revenue. On the other hand, the income effect of a decrease in the FCM grant could be offset, because if a municipality increases its revenue even though another municipality has made a greater effort, the available tax base is less extensive and it may see its revenue decrease. The magnitude of this compensation, i.e., the extent to which their fiscal decisions affect the available tax bases of other municipalities, depends on the relative size of the municipalities which exert more or less effort[50]. Note that if the assumption is made that there is no strategic interaction among local governments, the revenue collected is a good proxy for fiscal effort. Otherwise, if there is strategic interaction, all municipalities could simultaneously make more effort without increasing their collection. Further research on this topic should take into account theoretical and empirical models of strategic interaction among local governments.

7.2 Robustness analysis

Tables 14, 15, 16 and 17 present IV results which consider different regression specifications, regressors of interest and dependent variables. The first case presents the IV estimates not considering the proportions of revenue shifted to the FCM as covariates. The second case presents the IV estimates not considering the proportions of revenue shifted to the FCM as covariates, but the grants variable is represented by net grants. In the third case, the IPPP is considered the dependent variable (i.e., the resources that remain

[50] The potential for strategic interaction in the case of property taxes and municipal licenses is low because the cost of attracting taxpayers from outside the municipality is higher.

with the municipality) and the FCM grant is considered the grant variable. Finally, the fourth case uses the FCM grants determined by the distribution formula, rather than the received grant. In all cases[51], the estimates are slightly different than those presented in Table 11, but they should not be statistically different from them.

Tables 18, 19 and 20 present IV results based on different definitions of the sample used for the estimate. First, it presents IV results excluding municipalities which have "IPPP used in the distribution formula" outside a specific range [national average $\pm\, 0.5 \times$ "IPPP used in the distribution formula"'s standard deviations], and an "IPPP used in the distribution formula" which is always below or above the national average. Thus, only observations close to the kink point and which show variability over time were used, but also ensuring that the number of observations is sufficiently large. The estimates are expected to become less precise as the number of observations and municipalities is reduced. The results are very similar to those in Table 11, suggesting that the sample definition is appropriate and the identification strategy holds in a neighborhood around the kink point and for different sample definitions. Second, following empirical literature on municipal data, information from municipalities founded during the 1990-2007 time period, as well as from the municipalities which they were formerly part of, was excluded. Third, it considers the method for identifying outliers suggested by Hadi[52]. This method was applied to per capita local revenues series for each municipality, using a different significance level for outlier cutoff. If a municipality has an observation identified as an outlier, then that municipality was considered an outlier. Twenty outlier municipalities fall within this category. In both cases, the results are very similar to those shown in Table 11.

Finally, Table 21 is analogous to Table 11, except that the dependent variables are determined prior to the assignment variable ("IPPP used in the distribution formula"). If the assumption of smooth density of the assignment variable is reasonable, then we do not expect to see systematic evidence of kinks in predetermined variables (Card et al, 2009). The variables that were presumably determined before the "IPPP used in distribution formula" are poverty, SIMCE score and housing construction permits issued

[51] The standard deviation of net grants is very similar to the FCM grants' standard deviation, but the IPPP's standard deviation is half of the standard deviation of per capita local revenue.

[52] Hadi, 1992; Hadi, 1994.

by municipalities. All these variables are measured in the same years as the "IPPP used in the distribution formula"[53] and the point estimates are found to be statistically insignificant.

8 Conclusion

This paper analyzes the causal effect of intergovernmental grants on local revenue collection. Intergovernmental grants generate incentives for subnational governments which affect the total amount of resources collected, and thus such grants may produce effects other than the desired ones. When subnational governments are responsible for collecting taxes, the total amount of revenue collected depends mainly on their actions to improve the efficiency of tax collection and to search for alternatives sources of revenue. However, the revenue collection process is costly for subnational governments. Thus, although grants increase a jurisdiction's total revenue, because of an income effect the jurisdiction may collect less local revenue.

This paper focuses on estimating the income effect of intergovernmental grants (FCM grants) on local governments in Chile. However, there is an identification problem due to the endogeneity of grants. To solve this problem, a kink in the Chilean grant system was used. Specifically, this kink refers to a component of the grant system wherein this component functions only if municipalities have per capita local revenue below the national average. The analysis indicates that the instrument is both relevant and valid. The main finding is evidence of fiscal laziness, where an increase of one standard deviation in FCM grants is associated with a decrease between 0.25 and 0.32 standard deviations in per capita local revenue. This effect is not uniform for the different kinds of local revenue. However, the result holds for different regression specifications, dependent variables, grant measures and sample definitions. Note that the net effect of an exogenous increase in grants is positive, i.e., the negative effect on the collection of local resources is less than the increase in grants. Thus, the redistributive objective is met.

Further research is warranted on the effect of the design of horizontal redistributive grants

[53] These variables were considered contemporary to local revenue and the results did not change.

on revenue collected, because it may also generate incentives for subnational governments which affect the total amount of resources collected. Specifically, this occurs when local governments must contribute a portion of their collected revenue to financing these kinds of grants, and the distribution mechanism for these resources depends on the same local revenue which is collected.

Appendix A

Period	Treated	Control	Total
1990 - 1995	28	35	63
1993 - 1998	10	28	38
1996 - 2001	11	24	35
2000 - 2005	12	27	39
Total	61	114	175

Table 1: Control and treatment groups

Appendix B

Period	$\hat{\beta}_3$	% treated group's average revenue in the first triennium
1990 - 1995	-1.46	6%
1993 - 1998	-3.69	10%
1996 - 2001	-1.84	5%
2000 - 2005	-4.77	9%
All periods	-2.62	8%

Table 2: DID estimator

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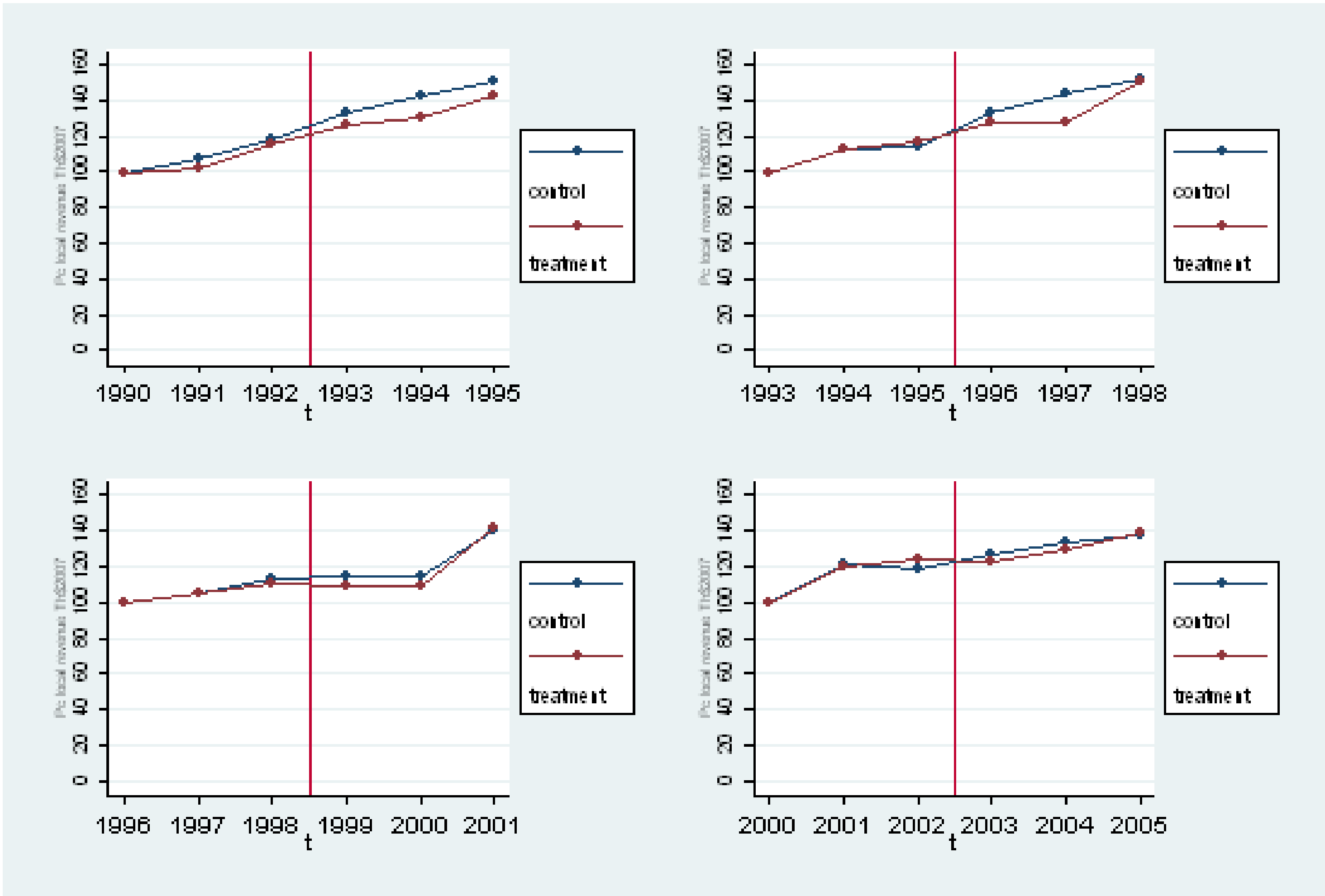

Figure 1: Per capita local revenue measured at base 100 for Treated and Control Groups

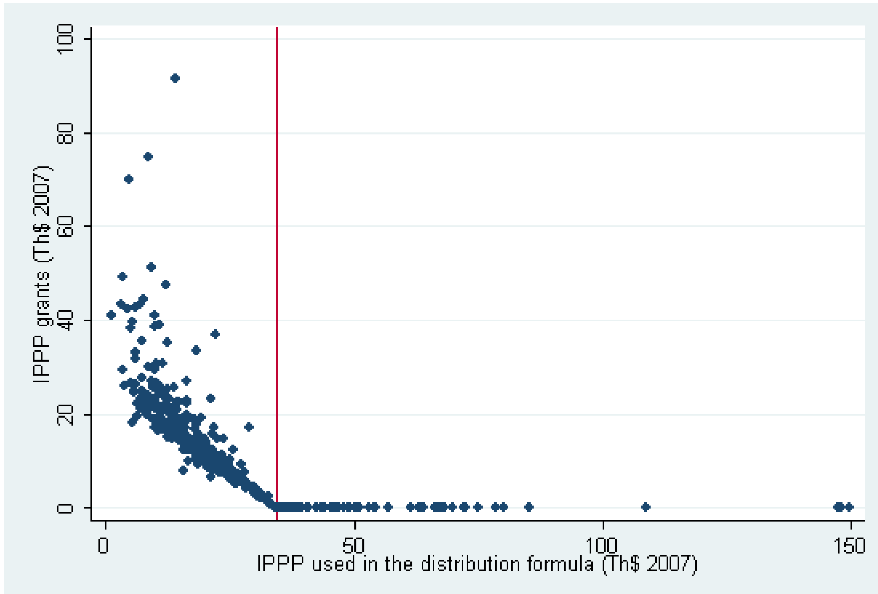

Figure 2: IPPP grant against "IPPP used in the distribution formula", 2003

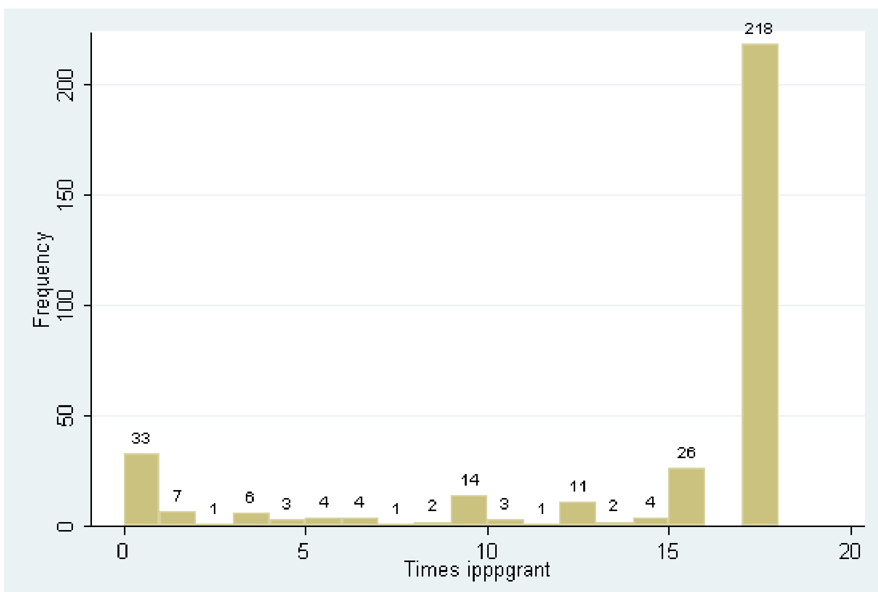

Figure 3: Frequency of the number of times the municipalities have received IPPP grant over the time period 1990-2007

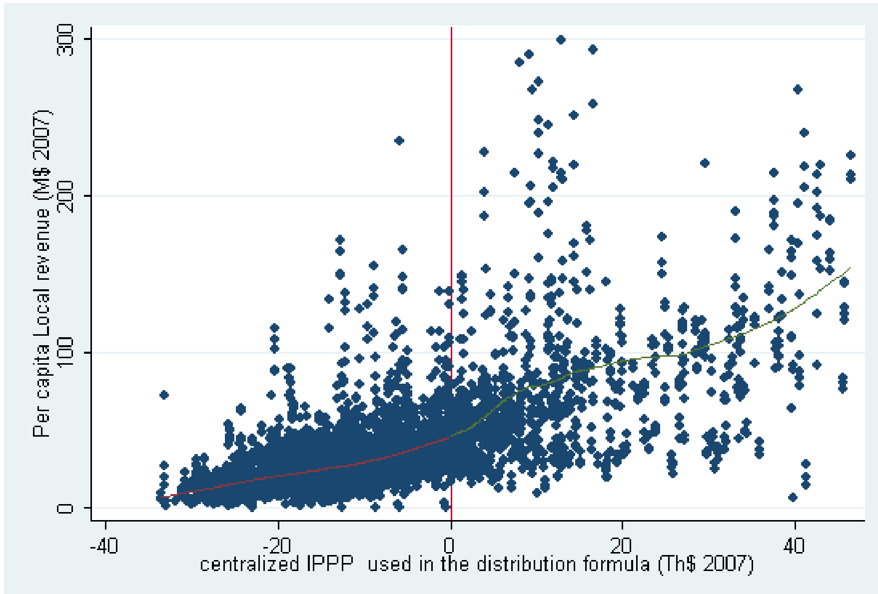

Figure 4: Collected local revenue against centralized "IPPP used in the distribution formula", 1990-2007

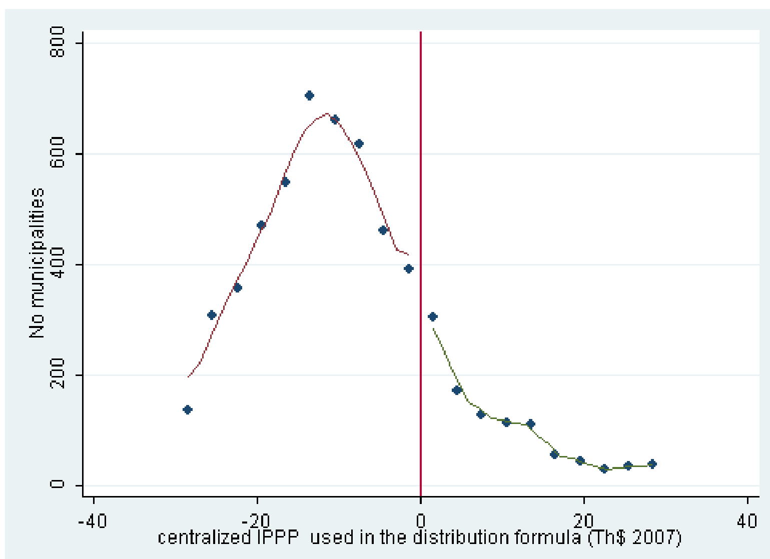

Figure 5: Number of observations in each bin of centralized "IPPP used in the distribution formula", 1990-2007

Component	1987-1995	1996-2000	2001-2002	2003-2005	2006-
Property tax	60%	60%	60% and 65% Las Condes, Vitacura, Stgo., Providencia	60% and 65% Las Condes, Vitacura, Stgo., Providencia	60% and 65% Las Condes, Vitacura, Stgo., Providencia
Vehicle registration fee	50%	50%	62.5%	62.5%	62.5%
Municipal License Fee	45% Stgo. and 65% Las Condes, Providencia	55% Stgo. and 65% Las Condes, Providencia, Vitacura	55% Stgo. and 65% Las Condes, Providencia, Vitacura	55% Stgo. and 65% Las Condes, Providencia, Vitacura	55% Stgo. and 65% Las Condes, Providencia, Vitacura
Transfers of Vehicle Tax		50%	50%	50%	50%
Fotorradares Fines				100%	100%
Fiscal Contribution	Determined by law	Determined by law	Determined by law	Determined by law	216.000 UTM

Table 3: Composition formula FCM

Period (triennium)	Years
1	1990 - 1992
2	1993 - 1995
3	1996 - 1998
4	1999 - 2002
5	2003 - 2007

Table 4: Duration 90% distribution coefficients

Period (triennium)	Data
1 (1990 - 1992)	Projected population of 1988 based on Censuses 1982
2 (1993 - 1995)	Preliminary count Censuses 1992
3 (1996 - 1998)	Projected population of 1994 based on Censuses 1992
4 (1999 - 2002)	Projected population of 1997 based on Censuses 1992
5 (2003 - 2007)	Population Censuses 2002

Table 5: Population Component

Period (triennium)	Data
1 (1990 - 1992)	Total and Exempt properties of 1988
2 (1993 - 1995)	Total and Exempt properties of 1991
3 (1996 - 1998)	Total and Exempt properties of 1994
4 (1999 - 2002)	Total and Exempt properties of 1997
5 (2003 - 2007)	Total and Exempt properties of 2001

Table 6: Exempt Properties Component

Period (triennium)	Data
1 (1990 - 1992)	
2 (1993 - 1995)	
3 (1996 - 1998)	Mothers schooling and height-age deficit of children between 0 and 6 years 1992 and 1993
4 (1999 - 2002)	Mothers schooling and height-age deficit of children between 0 and 6 years 1996 and 1997
5 (2003 - 2007)	Mothers schooling and height-age deficit of children between 0 and 6 years 2000 and 2001

Table 7: Relative Poverty Component

Period (triennium)	Data
1 (1990 - 1992)	IPP 1988 and Projected population of 1988 based on Censuses 1982
2 (1993 - 1995)	IPP 1991 and Preliminary count Censuses 1992
3 (1996 - 1998)	Average IPP 1992, 1993 and 1994 and Projected population of 1994 based on Censuses 1992
4 (1999 - 2002)	Average IPP 1995, 1996 and 1997 and Projected population of 1997 based on Censuses 1992
5 (2003 - 2007)	Average IPP 1999, 2000 and 2001 and Population Censuses 2002

Table 8: IPPP component

Component	1987-1995	1996-2007	2008
No of Municipalities (equal parts)	10%	10%	25%
No of inhabitants (population)	20%	15%	
No of exempt properties	30%	30%	30%
IPP per capita (IPPP)	40%	35%	35%
Relative Poverty		10%	10%

Table 9: Distribution Formula FCM

Period	$\hat{\beta}_3$	% treated group's average revenue in the first triennium
1990-1995	-2.84	13%
1993-1998	-4.93	14%
1996-2001	-3.83	11%
2000-2005	-4.67	10%
All periods	-4.29	14%

Table 10: DID estimator

Municipality	**1402**	**6309**	**8415**	**10404**	**11303**
Per capita local revenue 1990	2.3	14.9	4.93	9.26	4.22
Per capita local revenue 1991	2.65	13.01	4.55	9.88	5.89
Per capita local revenue 1992	3.59	12.42	4.13	22.61	6.21
Per capita local revenue 1993	6.96	14.03	12.54	17.94	3.11
Per capita local revenue 1994	7.34	13.62	4.02	11.91	3.29
Per capita local revenue 1995	6.7	17.77	7.75	13.16	3.17
Per capita local revenue 1996	5.08	21.07	7.73	18.52	3.70
Per capita local revenue 1997	4.07	22.87	14.61	17.13	9.42
Per capita local revenue 1998	19.87	26.92	7.27	16.89	5.19
Per capita local revenue 1999	25.77	29.00	8.7	21.76	5.33
Per capita local revenue 2000	123.64	23.15	7.33	20.71	3.91
Per capita local revenue 2001	1.14	25.82	11.18	16.99	4.29
Per capita local revenue 2002		299.39	6.46	22.02	116.83
Per capita local revenue 2003	5.77	29.04	3.77	921.31	131.90
Per capita local revenue 2004	11.6	30.25	7.85	23.61	180.29
Per capita local revenue 2005	5.93	27.03	28.85	29.34	179.02
Per capita local revenue 2006	13.51	29.42	37.42	28.89	274.14
Per capita local revenue 2007	6.72	29.66	82.57	24.7	211.82
Coefficient of Variation	1.935	1.739	1.32	3.071	1.43

Table 11: Per capita local revenue series of outlier municipalities

variable	**Obs.**	**Mean**	**Median**	**Standard Deviation**	**5th percentile**	**95th percentile**
X	5980	44.005	28.425	61.792	7.966	125.756
fcm	5975	53.298	29.406	104.506	7.417	154.859
ipppg	5974	10.155	8.300	10.696	0	27.437
ipppd	6026	22.621	15.849	27.100	4.351	61.349
proptax	5980	18.710	11.173	33.039	1.357	49.691
munlic	5983	7.120	3.239	17.192	0.635	21.739
vehreg	5984	9.985	5.360	19.202	1.230	34.724
orev	5981	8.338	4.916	12.525	0.821	26.456
$\alpha^{proptax}$	5980	0.6	0.6	0.003	0.6	0.6
α^{vehreg}	5980	0.549	0.5	0.061	0.5	0.625
α^{munlic}	5980	0.007	0	0.064	0	0
netgrant	5974	35.670	18.266	105.656	-17.085	140.207
ippp	5981	26.375	17.446	32.428	5.025	80.515
fcm2	5958	53.667	29.932	105.682	7.706	153.236
pop	6024	44837	16896	69179	2197	187000
poverty	6024	27.823	28.950	11.837	8.890	47.065
exprop	6029	8173.192	3593.000	12642.592	522	32781
simce	5422	161.292	221.500	88.062	47.855	251.191
permcons	3617	676.023	274	1175.103	28	2626

Table 12: Descriptive Statistics

Dependent Variable	Per capita local revenue										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Estimation	OLS	OLS	OLS	IV	IV	IV	IV	IV	IV	IV	IV
Polynomial order			2nd	2nd	3rd	4th	5th	2nd	3rd	4th	5th
FCM grant	0.00743	0.00623	0.0202**	-0.153***	-0.166***	-0.159***	-0.156***	-0.181**	-0.189***	-0.180***	-0.179***
	(0.00653)	(0.00664)	(0.00806)	(0.0589)	(0.0506)	(0.0455)	(0.0471)	(0.0705)	(0.0576)	(0.0519)	(0.0546)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Poverty		Yes	Yes					Yes	Yes	Yes	Yes
Population		Yes	Yes					Yes	Yes	Yes	Yes
Exempt properties		Yes	Yes					Yes	Yes	Yes	Yes
Observations	5,967	5,960	5,959	5,966	5,966	5,966	5,966	5,959	5,959	5,959	5,959
No comuna	340	340	340	340	340	340	340	340	340	340	340
First stage											
IPPP grant				1.665***	2.057***	2.162***	2.068***	1.512***	1.911***	2.013***	1.918***
t				5.45	8.69	9.23	8.09	4.83	7.90	8.39	7.32
F				29.72	62.87	539.19	535.14	23.33	52.40	478.43	529.28

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 13: Effects of FCM grants on local revenue

Dependent Variable	Tax property	Municipal Fee	Vehicle Registration	Other revenue	Tax property	Municipal Fee	Vehicle Registration	Other revenue
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation	IV	IV	IV	IV	IV	IV	IV	IV
Polynomial order	2nd	2nd	2nd	2nd	3rd	3rd	3rd	3rd
FCM grant	-0.010***	-0.078***	0.034	-0.007	-0.096***	-0.086***	0.026	-0.0044
	(0.0297)	(0.0274)	(0.0244)	(0.0125)	(0.0219)	(0.0237)	(0.0278)	(0.0113)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,966	5,966	5,966	5,966	5,966	5,966	5,966	5,966
No comuna	340	340	340	340	340	340	340	340
First stage								
IPPP grant	1.665***	1.665***	1.665***	1.665***	2.057***	2.057***	2.057***	2.057***
t	5.45	5.45	5.45	5.45	8.69	8.69	8.69	8.69
F	29.72	29.72	29.72	29.72	62.87	62.87	62.87	62.87

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 14: Effects of FCM grants on different kind of local revenue

Dependent Variable	Tax property	Municipal Fee	Vehicle Registration	Other revenue	Tax property	Municipal Fee	Vehicle Registration	Other revenue
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation	IV	IV	IV	IV	IV	IV	IV	IV
Polynomial order	4th	4th	4th	4th	5th	5th	5th	5th
FCM grant	-0.104***	-0.075***	0.037*	-0.011	-0.118***	-0.082***	0.048**	-0.001
	(0.0223)	(0.0207)	(0.0203)	(0.0105)	(0.0254)	(0.0203)	(0.0200)	(0.0106)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,966	5,966	5,966	5,966	5,966	5,966	5,966	5,966
No comuna	340	340	340	340	340	340	340	340
First stage								
IPPP grant	2.163***	2.163***	2.163***	2.163***	2.069***	2.069***	2.069***	2.069***
t	9.23	9.23	9.23	9.23	8.09	8.09	8.09	8.09
F	539.19	539.19	539.19	539.19	535.14	535.14	535.14	535.14

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 15: Effects of FCM grants on different kind of local revenue (cont.)

Dependent Variable	Per capita local revenue			
	(1)	(2)	(3)	(4)
Polynomial order	2nd	3rd	4th	5th
FCM grant	-0.174***	-0.271***	-0.244***	-0.238***
	(0.0658)	(0.0646)	(0.0588)	(0.0632)
Fixed effects	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
% revenue shifted to FCM	No	No	No	No
Observations	5,966	5,966	5,966	5,966
No of comuna	340	340	340	340
First stage				
IPPP grant	1.663***	1.981***	2.118***	2.023***
t	5.40	7.93	8.79	7.52
F	29.15	62.90	539.39	535.33

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 16: Effects of grants on local revenue, without proportions of revenue shifted to the FCM. Robustness analysis

Dependent Variable	Per capita local revenue			
	(1)	(2)	(3)	(4)
Polynomial order	2nd	3rd	4th	5th
Net grant	-0.164***	-0.239***	-0.217***	-0.213***
	(0.0578)	(0.0504)	(0.0470)	(0.0508)
Fixed effects	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
% revenue shifted to FCM	No	No	No	No
Observations	5,965	5,965	5,965	5,965
No of comuna	340	340	340	340
First stage				
IPPP grant	1.764***	2.250***	2.377***	2.263**
t	5.83	9.14	9.94	8.59
F	33.99	83.54	502.55	503.67

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 17: Effects of net grants on local revenue. Robustness analysis

Dependent Variable	IPPP			
	(1)	(2)	(3)	(4)
Polynomial order	2nd	3rd	4th	5th
FCM grant	-0.112***	-0.133***	-0.119***	-0.118***
	(0.0385)	(0.0340)	(0.0308)	(0.0336)
Fixed effects	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
% revenue shifted to FCM	No	No	No	No
Observations	5,967	5,967	5,967	5,967
No of comuna	340	340	340	340
First stage				
IPPP grant	1.662***	1.977***	2.114***	2.019***
t	5.40	7.93	8.79	7.52
F	29.19	62.87	540.09	536.02

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 18: Effects of FCM grants on IPPP. Robustness analysis

Dependent Variable	Per capita local revenue			
	(1)	(2)	(3)	(4)
Polynomial order	2nd	3rd	4th	5th
FCM grant determined by formula	-0.411	-0.364**	-0.355**	-0.409**
	(0.275)	(0.148)	(0.139)	(0.199)
Fixed effects	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes
Observations	5,950	5,950	5,950	5,950
No of comuna	340	340	340	340
First stage				
IPPP grant	.848***	1.381***	1.483***	1.225**
t	1.95	4.26	4.45	3.05
F	3.78	13.82	491.54	480.64

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 19: Effects of FCM grants determined by distribution formula on local revenue. Robustness analysis

Dependent Variable	Per capita local revenue			
	(1)	(2)	(3)	(4)
Polynomial order	2nd	3rd	4th	5th
FCM grant	-0.0968***	-0.102***	-0.104***	-0.103***
	(0.0366)	(0.0377)	(0.0379)	(0.0376)
Fixed effects	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes
Observations	3,568	3,568	3,568	3,568
No of comuna	256	256	256	256
First stage				
IPPP grant	2.514***	2.500***	2.510***	2.518**
t	8.55	8.42	8.49	8.52
F	73.11	70.93	69.17	294.35

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 20: Effects of FCM grants on local revenue. Municipalities close to kink point.

Dependent Variable	Per capita local revenue			
	(1)	(2)	(3)	(4)
Polynomial order	2nd	3rd	4th	5th
FCM grant	-0.156***	-0.167***	-0.157***	-0.152***
	(0.0603)	(0.0516)	(0.0463)	(0.0480)
Fixed effects	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes
Observations	5,651	5,651	5,651	5,651
No of comuna	317	317	317	317
First stage				
IPPP grant	1.654***	2.045***	2.154***	2.054***
t	5.35	8.46	9.02	7.89
F	28.60	59.53	526.29	523.81

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 21: Effects of FCM grants on local revenue. Without new municipalities.

Dependent Variable	Per capita local revenue			
	(1)	(2)	(3)	(4)
Polynomial order	2nd	3rd	4th	5th
FCM grant	-0.166***	-0.174***	-0.165***	-0.164***
	(0.0622)	(0.0532)	(0.0480)	(0.0499)
Fixed effects	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes	Yes
Observations	5,716	5,716	5,716	5,716
No of comuna	326	326	326	326
First stage				
IPPP grant	1.654***	2.034***	2.134***	2.038***
t	5.34	8.37	8.86	7.76
F	28.52	58.30	488.97	484.05

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 22: Effects of FCM grants on local revenue. Definition outlier according to Hadi.

Dependent Variable	Poverty	SIMCE	Construction Permits
	(1)	(2)	(3)
Polynomial order	4th	4th	4th
FCM grant	0.004	-0.004	-1.217
	(0.00919)	(0.0105)	(2.709)
Fixed effects	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes
% revenue shifted to FCM	Yes	Yes	Yes
Observations	5,966	5,292	3,597
No of comuna	340	338	224
First stage			
IPPP grant	2.162***	1.931***	1.360***
t	9.23	7.97	31.18

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 23: Effects of grants on predetermined covariates.